9. Affected Environment and Environmental Consequences (Human Environment)

9.1 Growth and Development

9.1.1 Current Population

As stated in the Final Environmental Assessment for Alternative Sand Sources and Stormwater Outfall Extensions for the Rehoboth Beach and Dewey Beach Storm Damage Reduction Program (USACE 2002):

> Rehoboth Beach is part of a headland-spit complex, which terminates in the north at Cape Henlopen. Land uses within Rehoboth Beach are primarily composed of beachfront properties (residences, retail businesses, lodging), boardwalks, and undeveloped portions. The beachfront properties consist primarily of three distinct areas of development. The southern-most section of Rehoboth Beach consists of single-family homes and a boardwalk fronts the properties on the ocean side of the properties north of Prospect Street. Above that area, a commercially developed area consisting of hotels, restaurants, retail stores, condominium, and an arcade is located from Philadelphia Street to Lake Street. A boardwalk fronts the ocean side of this area. The northern section of Rehoboth Beach from Lake Avenue to Henlopen Avenue consists of single-family homes. Henlopen Acres and North Shores located north of Rehoboth Beach are private residential developments.

According to the 2010 census, the current population of Rehoboth Beach is 1,327 persons. Detailed population information for Rehoboth Beach is presented in Table 9-1 (U.S. Census Bureau 2010). The historical population trend in Rehoboth is presented in Figure 9-1, and the historical and projected populations within Sussex County and Delaware are presented in Figure 9-2.

Table 9-1 2010 Census Data for Rehoboth Beach, DE (U.S. Census Bureau 2010)

Subject	Number of Persons	Percent of Total
POPULATION		
Total population	1,327	100.0
RACE		
One race	1,324	99.8
White	1,291	97.3
Black or African American	15	1.1
American Indian and Alaska Native	3	0.2
Asian	9	0.7

Subject	Number of Persons	Percent of Total
Native Hawaiian and Other Pacific Islander	0	0.0
Some Other Race	6	0.5
Two or More Races	3	0.2
HISPANIC OR LATINO AND RACE		
Hispanic or Latino (of any race)	48	3.6
Not Hispanic or Latino	1,279	96.4
One race	1,276	96.2
White	1,257	94.7
Black or African American	7	0.5
American Indian and Alaska Native	3	0.2
Asian	9	0.7
Native Hawaiian and Other Pacific Islander	0	0.0
Some Other Race	0	0.0
Two or More Races	3	0.2
HOUSING UNITS		
Total Housing Units	3,219	100.0
OCCUPANCY STATUS		
Occupied housing units	761	23.6
Vacant housing units	2,458	76.4

Figure 9-1 Historic Population Trend for the City of Rehoboth Beach (Rehoboth Beach-Dewey Beach Chamber of Commerce 2009)

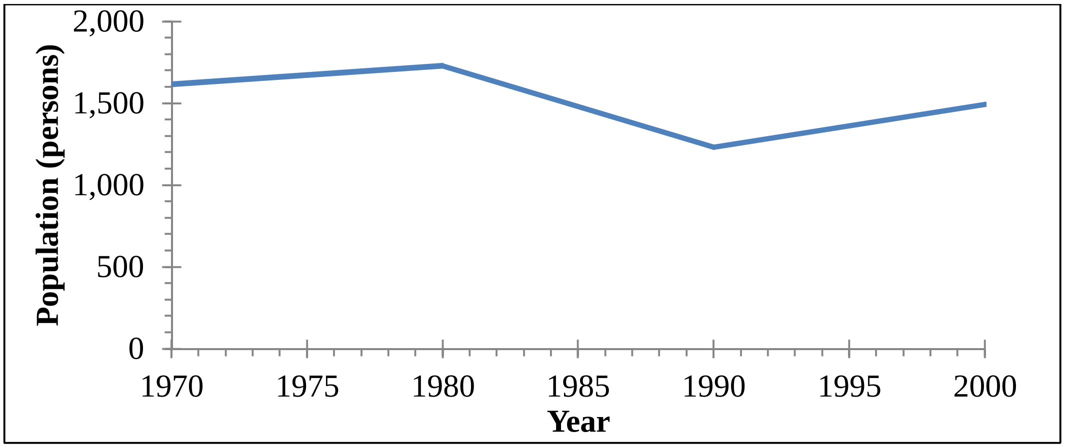
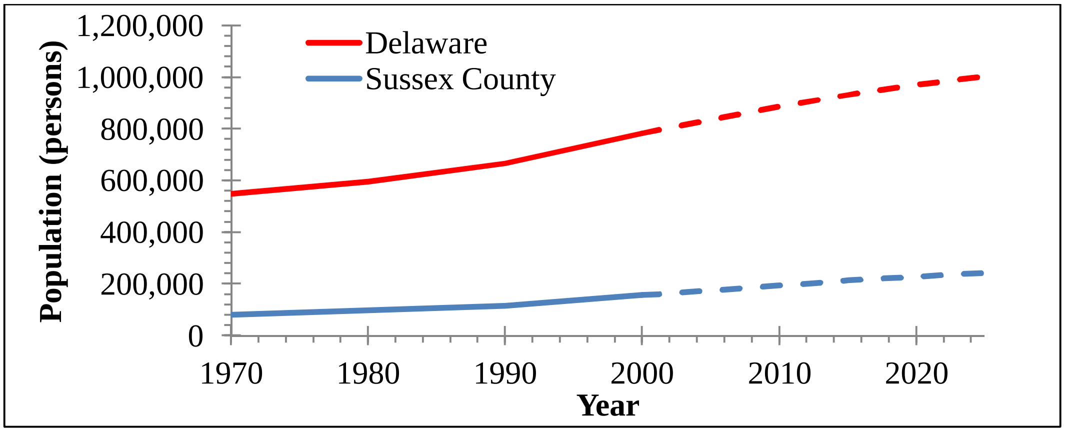


Figure 9-2 Historic and Projected Population for the Delaware and Sussex County (Rehoboth Beach-Dewey Beach Chamber of Commerce 2009)



9.1.2 Short Term / Temporary Impacts

9.1.2.1 No Action

The no action alternative will not involve any construction, and thus, there will be no short term impact to growth or development.

9.1.2.2 Land Application

Minor impacts to growth and development in the area may result from the disruption of the area caused by construction of the land application facility and/or forcemain.

9.1.2.3 Ocean Outfall

Minor impacts to growth and development in the area may result from the disruption of the area caused by construction of the ocean outfall forcemain.

9.1.3 Long Term / Chronic Impacts

9.1.3.1 No Action

The no action alternative will not increase the design capacity of the RBWWTP, and thus there will be no impact on growth or development within the service area.

9.1.3.2 Land Application

The land application alternative will not increase the design capacity of the RBWWTP. In addition, a land application facility will protect the irrigated area from any development while the facility is in operation. However, the land is also prohibited from being used for growing crops and raising livestock (DNREC 1999).

9.1.3.3 Ocean outfall

The ocean outfall alternative will not increase the design capacity of the RBWWTP, and thus there will be no impact on growth or development within the service area. All disturbed land outside of the RBWWTP will be returned to grade and the buried pipeline will not affect land use.

9.2 Environmental Justice

Executive Order 12898, Environmental Justice, was issued by the President on February 11, 1994. The objective of the Executive Order is to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations, low-income populations, and Indian tribes and allowing all portions of the population a meaningful opportunity to participate in the development of, compliance with, and enforcement of Federal laws, regulations, and policies affecting human health or the environment regardless of race, color, national origin, or income (CEQ 1997).

A Disproportionately High and Adverse Effect on Minority and Low-Income Populations means an adverse effect that (FHWA 1998):

1. is predominately borne by a minority population and/or a low-income population; or
2. will be suffered by the minority population and/or low-income population and is appreciably more severe or greater in magnitude than the adverse effect that will be suffered by the nonminority population and/or nonlow- income population.

9.2.1 Demographic background

According to 2010 Census, the population of the City of Rehoboth Beach (City) is 1,327 with a greater proportion of non-minority persons than Sussex County, state of Delaware, or the United States. Table 9-2 shows the racial composition of the City of Rehoboth Beach as compared to Sussex County and the state of Delaware.

Table 9-2 Racial composition (U.S. Census Bureau 2010)

Race	Rehoboth Beach	Sussex County	State of Delaware	USA
White	94.7%	79.0%	68.9%	63.7%
Black	0.5%	12.7%	21.4%	12.2%
American Indian and Alaska Native	0.2%	0.8%	0.5%	0.7%
Asian	0.7%	1.0%	3.2%	4.7%
Native Hawaiian and Other Pacific Islander	0.0%	0.1%	0.0%	20.0%

Personal income in the City is significantly higher than in Sussex County or the State of Delaware. According to 2010 Census, the median household income in Rehoboth Beach is $66,844, significantly higher compared to $50,024 in Sussex County and $56,985 in the State of Delaware (U.S. Census Bureau 2010).

The City has a lower percentage of persons living in poverty as compared to the State as a whole. Poverty status is determined by the U.S. Census by the use of specific poverty thresholds identified and refined each year by the federal government. Poverty thresholds are the statistical version of the poverty measure and are issued by the U.S. Census Bureau. They are used for calculating the number of persons in poverty in the United States or in states and regions. For example, the poverty threshold for a family of four in the 2010 Census was an annual income of $22,050, not including public assistance or other unearned income. The percentage of residents below poverty level in Rehoboth Beach is 5.2%. The poverty status data and its distribution by race are shown in Table 9-3 and Table 9-4.

Table 9-3 Poverty status (U.S. Census Bureau 2010)

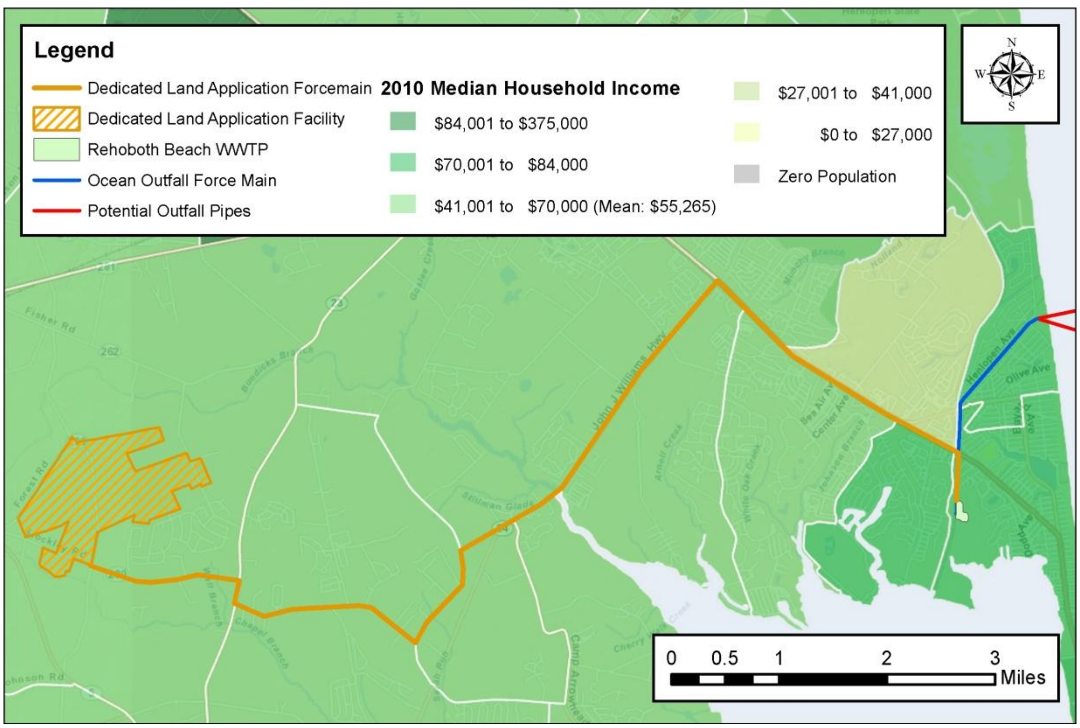
Poverty group	City of Rehoboth Beach	State of Delaware
Residents with income below the poverty level	5.2%	10.8%
Residents with income below 50% of the poverty level	1.8%	4.9%

Table 9-4 Residents below poverty level by races (U.S. Census Bureau 2010)

Races	City of Rehoboth Beach
White	100%
Black, American Indian and Alaska Native, Asian, Native Hawaiian and Other Pacific Islander	0%

Figure 9-3 shows the distribution of population around the proposed project based on median household income. There is no area with a concentration of low income household. Therefore, any adverse impact, if any, would not predominately be borne by a minority population and/or a low-income population.

Figure 9-3 Median household income surrounding project area



9.2.2 Adverse environmental impacts

Environmental justice analysis need be applied only to adverse environmental impacts. Adverse impact is defined as a negative effect on human health or the environment that is significant, unacceptable or above generally accepted norms (DAF 1997). It may include bodily impairment, infirmity, illness, or death. Adverse environmental effects may include ecological, cultural, human health, economic, or social impacts when interrelated to impacts on the natural or physical environment.

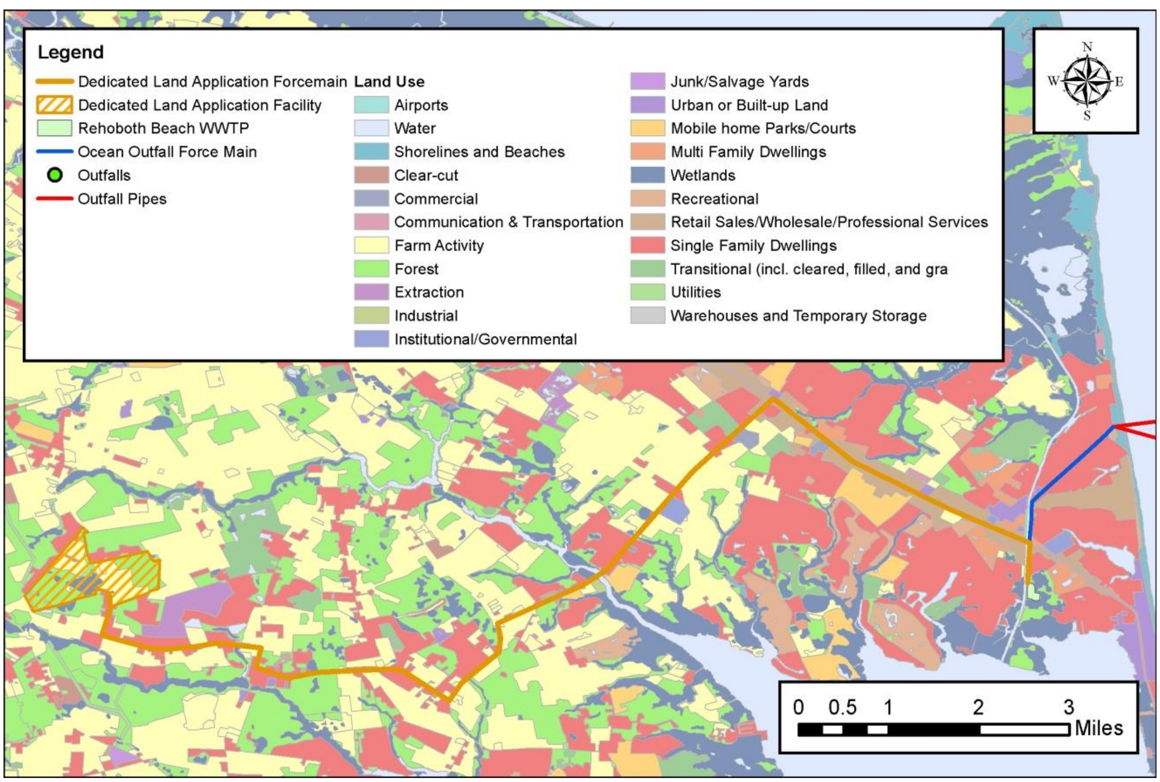
As described in the previous sections of this report, there is no adverse environmental impact anticipated as a result of the proposed action, construction of an ocean outfall and its supporting facilities. The outfall will be extend 6,000 LF east from the Deauville Beach parking area and terminate with a diffuser pipe located approximately 40 feet under water. The Deauville Beach access parking lot located at the intersection of Henlopen Ave and Duneway provides adequate space for construction and should minimize disruption to local businesses and residences. The proposed alignment for the forcemain from the effluent pumping station at the RBWWTP to the ocean outfall will be constructed to follow the alignment of existing utilities and roadways and will not require excavation of any undeveloped land. As discussed in Chapter 8 of this report, adverse impacts to terrestrial, wetlands, aquatic, or endangered species are expected to be minimal for the proposed project. Because there would be no adverse environmental impacts, an environmental justice analysis is not required.

9.3 Planning

9.3.1 Current Land Use

Current land use in the vicinity of the project is shown in Figure 9-4.

Figure 9-4 Current Land Use



9.4 Community Facilities

Community facilities include schools, libraries, cultural facilities, fire and police services, hearth services, public utilities and transportation.

During construction of either the land application or ocean outfall alternative, minor impacts to community facilities may occur due to traffic control along the proposed forcemains. However, this impact will be minor, and will be managed to minimize impacts.

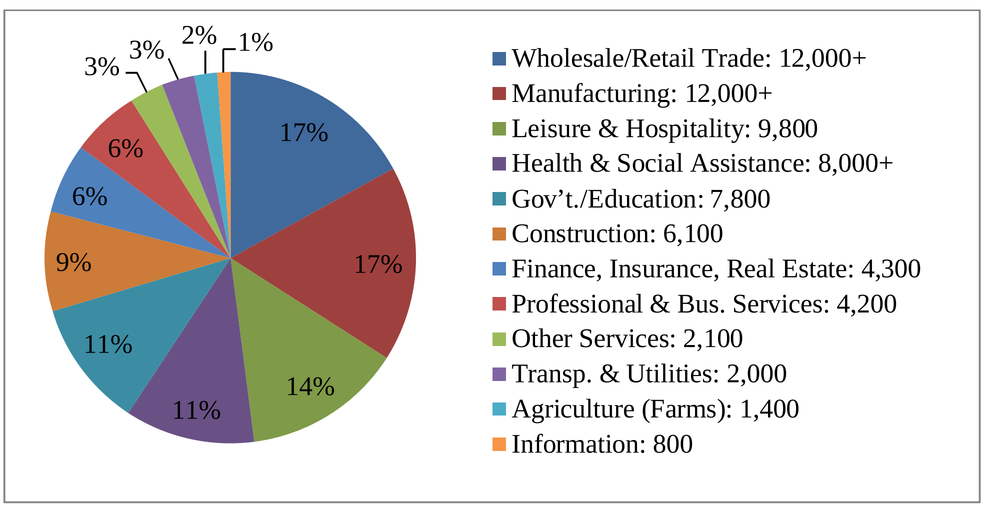
None of the effluent disposal alternatives will have any long term impacts on community facilities. Although wastewater treatment is a public utility, all impacts will be downstream of RBWWTP, so public utility service will not be impacted.

9.5 Economics

9.5.1 Local Economy

Tourism is the largest industry in Sussex County, with over 3.2 million person visits into the county in 2007 (Delaware Economic Development Office (DEDO) 2007). In 2005, tourism employed more than 10,540 people with an estimated economic impact of over $709 million (Rehoboth Beach-Dewey Beach Chamber of Commerce 2009). Over 16% of private employment in the county is in the leisure and hospitality industries, with another 18% in the retail trade industry (Rehoboth Beach-Dewey Beach Chamber of Commerce 2009). Agriculture, specifically chicken farming, is also a major component of the Sussex County economy. In 2004, the value of agriculture in the county was estimated at $798.4 million. A breakdown of jobs by industry in Sussex County is presented in Figure 9-5.

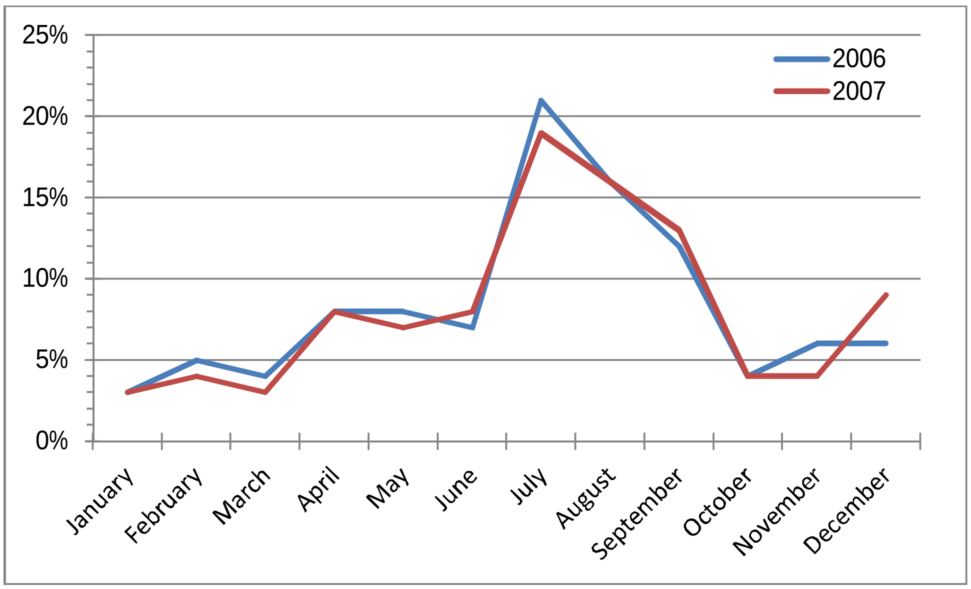
Figure 9-5 Total Jobs by Industry in Sussex County (Rehoboth Beach-Dewey Beach Chamber of Commerce 2009)



As presented in

Figure 9-6, tourism in the area is seasonal with the most tourism occurring in July and the least in January. Rehoboth Beach is the most developed and heavily populated resort area on the coast of Delaware (USACE 1996).

Figure 9-6 Monthly Visitor Volume for Sussex County during 2006 and 2007 (Delaware Economic Development Office (DEDO) 2007)



The quality of water has an important role in sustaining the economic prosperity of beach tourism. Even the perception of bad water quality could hurt tourism industry. For instance, in the Spring of 2010, before the oil from BP's offshore spill was affecting states other than Louisiana, Gulf Coast states from Alabama to Florida experienced a huge drop in coastal hotel bookings and a large number of cancellations from tourists whose perception was that beach water quality at these destinations was impacted by the spill (Dorfman and Rosselot 2010).

Beach closure due to poor water quality generates substantial impact to state and local governments, businesses, and communities in general. Economists estimate a typical swimming day is worth $30.84 to each individual. Depending on location and the number of potential visitors, the total number could be significant. For example, depending on the value assumptions used, the typical beach closure could cause a net economic loss among would-be swimmers of up to $37,030/day (Rabinovici, et al. 2004). From a public health perspective, a total of $3.3 million cumulative lost on wages and medical care is expected annually to treat the more than 74,000 incidences of gastrointestinal illness due to polluted recreational marine water in two beaches in Southern California, i.e. Huntington Beach and Newport Beach (Dwight, et al. 2005). This annual number can be broken down into $1.3 million public health cost from gastrointestinal illness,

$951,378 from acute respiratory disease, $767,221 from ear ailments, and $304,335 from eye ailments. It is important to mention that the main source of bacterial contamination in Southern California beaches is storm water runoff. A study by Ahn, et al. (2005) shows that the storm water runoff from Santa Anna River leads to very poor water quality along Orange County surf zone including Huntington Beach and Newport Beach, with fecal indicator bacteria concentrations exceeding California beach water standards by up to 500%. Based on the same contamination assumption, another study reported that fecal contamination at 28 beaches in Los Angeles and Orange County in California caused between 627,800 and 1,479,200 excess gastrointestinal illnesses with a public health cost of $21 million to $51 million each year (Given, Pendleton and Boehm 2006). However, as noted in Section 4.2.6, the Orange County Sanitation District discharges 245 mgd of 65% secondary treated wastewater and 35% primary effluent which has been disinfected only since 2002.

Exceeding the allowable level of bacterial contamination in beach water was responsible for 13,809 days (74%) of beach closings reported in 2009. In addition, storm water runoff contributed to at least 80% of all closing and advisory days in cases where there was a reported contamination source (Dorfman and Rosselot 2010). Due to the advanced level of treatment in wastewater treatment plants, the effluent cannot be considered a major source of bacteria but should not be ruled out (Surbeck, et al. 2008).

Excess nutrient content (nitrate and phosphorus) from urban and agricultural runoff and treatment plant effluent can increase the growth of harmful algal blooms. Impacts specific types of algal blooms include mass mortalities of wild and farmed fish and shellfish; human intoxication and death from the consumption of contaminated shellfish or fish; alterations of marine food webs through adverse effects on larvae and other life stages of commercial fish species; and the noxious smell and the appearance of algae accumulated in waters near shoreline or deposited on beaches. The estimated annual impact of harmful algal blooms (including public health, commercial fisheries, recreational and tourism, and coastal monitoring and management) in the U.S. is $49 million per year with cumulative impacts over the last several decades approaching $1 billion (Anderson, et al. 2000).

9.5.2 Examples of Beach Communities

9.5.2.1 Virginia Beach, Virginia

Throughout the years, Virginia Beach has been recognized as one of the best beach destinations in the country (e.g. #9 of “Best Beach Destinations” in *Southern Living*’s Readers’ Choice Awards, #12 in Trip Advisor’s listing of “Best Family Friendly Vacations”, #6 in Money Magazine’s “Best Big City in the U.S.”). Visitors to Virginia Beach spent an estimated $816 million in 2009. The total economic impact of visitor spending is roughly $1.34 billion dollars and creates 12,500 jobs and $323 million dollars in earnings in Virginia Beach in 2009 (Yochum and Agarwal 2010). This growing tourism industry depends heavily on the condition of the 14 miles of beach and a total of 35 miles of waterfront properties.

Wastewater from City of Virginia Beach is treated by the Atlantic Treatment Plant owned by Hampton Roads Sanitation District. This facility has earned prestigious national awards for outstanding permit compliance for more than 17 consecutive years. It also has received national and regional US EPA awards for wastewater management excellence for its program to beneficially recycle biosolids. Other honors include a National Environmental Achievement Award for its Ocean Lakes High School Environmental Education Program. The facility is located five miles south from downtown Virginia Beach. The plant has been operating since 1983 and treats up to 36 million gallons per day of wastewater. Treated effluent from this WWTP is discharged directly to the Atlantic Ocean through a 66-inch diameter outfall pipe and multi-port diffuser, to an area approximately 1.5 miles offshore (HRSD 2006).

To date, there have been no closures or advisories in any of the beaches in Virginia Beach due to wastewater contaminations including any possible impact from the wastewater outfall. In 2009, only 0.5% of all reported beach closures/advisories in the State of Virginia occurred in Virginia Beach. The three days of beach closures/advisories were due to monitoring samples that exceeded the State's daily maximum bacterial standards. However, no specific source of contamination was reported (Dorfman and Rosselot 2010). The source could very likely have been from stormwater. Virginia Beach currently has a capital project underway to construct several stormwater pumping stations to pump stormwater offshore.

Some statistics from the tourism industry are offered as empirical evidence of any potential short or long term impact of an ocean outfall on economic growth in Virginia Beach. Since 1981, there has been a steady growth of hotel room supply in Virginia Beach (Figure 9-7). This growth is evidence of an increase in demand from overnight visitors. The same trend applies to total visitor spending and city revenue (Figure 9-8). However, due to recent nationwide economic downturn, some decline has been experienced in the past two years.

Figure 9-7 City of Virginia Beach Hotel rooms (Yochum and Agarwal 2010)

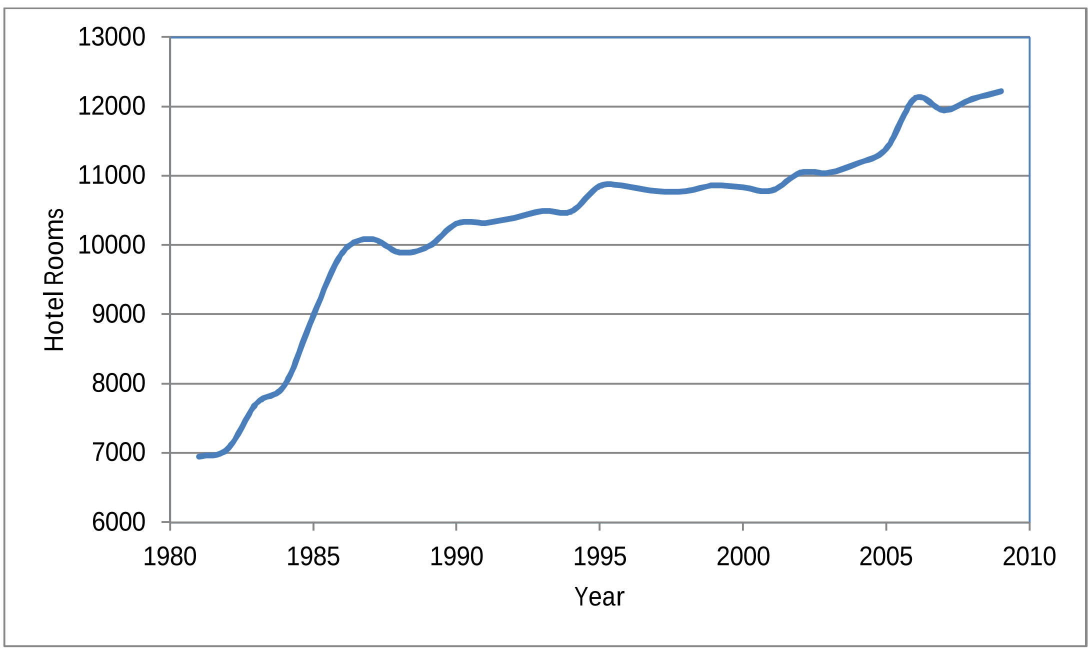
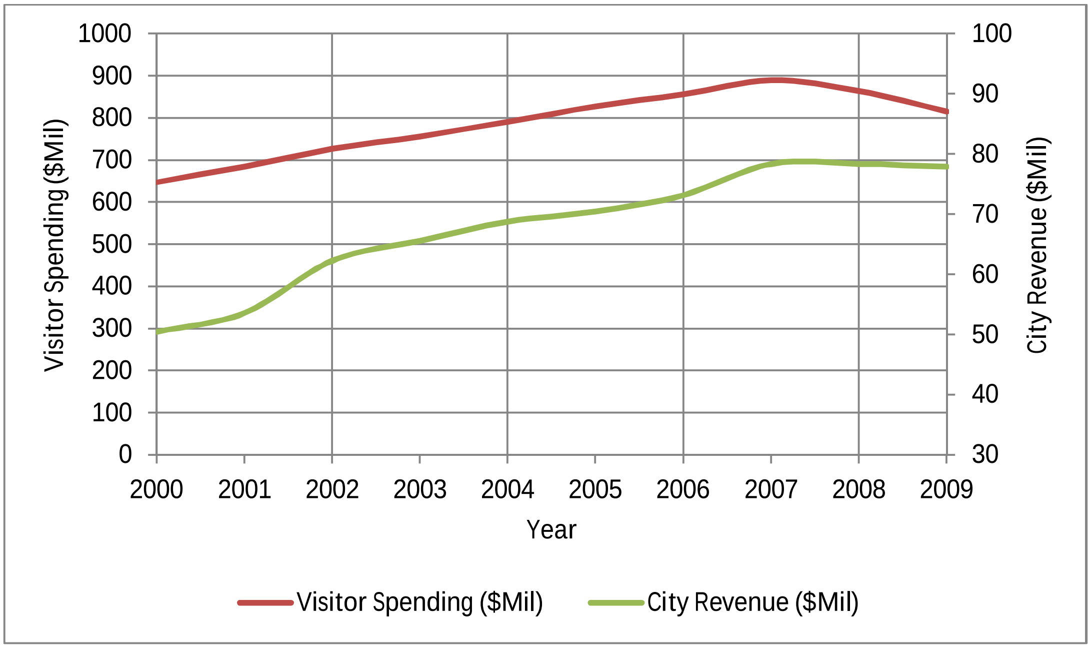


Figure 9-8 City of Virginia Beach Visitor spending and city revenue (Yochum and Agarwal 2010)



The Virginia Beach Convention and Visitor Bureau offices were contacted and were asked if they experienced any impacts on tourism or any economic impacts associated with the treated municipal wastewater ocean outfall. Representatives stated they were not aware of any concerns associated with the outfall, and the residents and tourists generally are not aware of its existence. The City of Virginia Beach is currently building several storm water pumping stations with ocean discharge to pump peak storm water runoff from the coastal highway area. Despite the very visible nature of the construction, city personnel have stated that there are no concerns on tourism.

9.5.2.2 Ocean City, Maryland

Ocean City also has an ocean outfall that has been discharging treated wastewater since 1970. The Ocean City outfall system includes an outfall pumping station located at the WWTP, approximately 700 feet of ductile iron pipe from the WWTP to the beach area, an air release valve vault just short of the beach, and 4,600 feet of pre-stressed concrete cylinder pipe discharging to a diffuser section, which is approximately 30 feet below the water surface. The 1,000 foot long diffuser has 49 risers (four inch each) which extend approximately seven feet above the center line of the pipe, ending in four inch by four inch tees that are intended to discharge effluent parallel to the beach. The effluent is diluted to one part effluent to 200 parts water (Town of Ocean City 2011). The flow design capacity of the outfall is 14 mgd with an average flow of 4.78 mgd and a maximum summertime flow of 10.79 mgd (USEPA 1992).

The Ocean City Department of Public Works was contacted regarding their experience with the ocean outfall. To date, they were not aware of any concerns about impacts the ocean outfall to tourism or the economy. The Natural Resources Defense Council (NRDC) tracks the health of our nations' beaches and annually rates beaches based on the water quality as established by monitoring for public health standards. Ocean City beaches have regularly received the highest rating possible (five stars) as a result of their beach monitoring program, which consistently shows clean water quality (Beckman, Devine and Mehta 2010).

9.5.2.3 Bethany Beach, Delaware

Bethany Beach is another popular beach community located just south of Rehoboth Beach, Delaware. Treated effluent from the South Coastal Wastewater Treatment Plant is discharged through an ocean outfall located off the coast of Bethany Beach. The outfall pipe extends approximately one mile out from the coast. The design flow capacity of the outfall is six mgd with average peak flow of three mgd during summer months. The average flow capacity during the winter months is 0.7 mgd (USEPA 1992).

The NRDC has given Bethany Beach a high rating for its excellent beach monitoring program and years of consistent high water quality without beach closures being required (USEPA 1992).

9.5.2.4 Southern California Beaches

In 1906, the City of Los Angeles built its first major ocean outfall in a portion of the Pacific Ocean called the Southern California Bight. Since then, larger outfalls have been built within the Bight to discharge waste as much as 7 miles offshore and 330 feet deep. By 1984, the total discharge from seven outfalls was 1,166 million gallons per day. Due to the minimum level of treatment provided, wastewater pollution began to impact the estuarine and coastal areas. Many beaches were quarantined from public access. During 1971 to 1983, after major upgrades to the treatment facility, the effluent quality has improved. The suspended solid and biochemical oxygen demand reduced by 15% and 10%, respectively. Arsenic, cadmium, chromium, copper, mercury, nickel, and lead have been reduced by 50-70%. More facility upgrades in 1983 to 1990 continued to improve the effluent quality. Because mixing characteristics of the effluent and ocean water are different during winter months, occasional chlorination is necessary to maintain state water quality standard for shellfish (Gunnerson, et al. 1988).

The results of outfall designs and source control measures in the Southern California Bight are noticeable. Beaches that were quarantined prior to 1950 are open and among the least contaminated in the world and have generated substantial tourism revenues for the coastal communities. The outfall discharges have not adversely affected fisheries since the Bight continues to support a large commercial fishing industry. More than 70% of all commercial fish landed in Southern California are caught within 31 miles of the three largest outfalls. Fish stocks in the Southern California Bight have remained constant except where overfishing or climatic change has caused declines (Gunnerson, et al. 1988).

Long term monitoring in the Southern California Bight has concluded that the ocean outfalls for treated effluent are not causing unacceptable effects on coastal environment.

A more recent study by Maruya et al. (2009) concerning emerging contaminants in sediments and fish near ocean outfalls in southern California studied several coastal locations near ocean outfalls, and compared them to a control location far from any ocean outfalls. Samples were collected in the vicinity of outfalls from two secondary wastewater treatment plants, each with a discharge capacity of 320 mgd, a secondary/primary (50/50%) treatment plant with a discharge capacity of 320 mgd, and an advanced primary treatment plant with a discharge capacity of 170 mgd. PCBs, PBDEs, PPCPs, and other contaminants were detected at higher concentrations in both the sediment and fish liver samples at the locations near ocean outfalls as compared to the control; however, no harmful effects were reported.

Another recent study by Yamahara et al. (2012) investigated bacterial pathogens and indicator organisms on beaches along the California coast. The pathogen *Staphylococcus aureus* was detected on 14% of the beaches tested, and methicillin-resistant *Staphylococcus aureus*, commonly known as MRSA, was found on 3% of beaches tested. Based on the spatial distribution of their data, the study concludes that “The presence of a putative source (storm drain, river, or stream) was positively associated with densities of *S. aureus* but not with any other microbes (Yamahara, et al. 2012). Treated effluent discharge was not investigated as a putative sources in this study.

9.5.3 Short Term / Temporary Impacts

9.5.3.1 No Action

The no action alternative will not involve any construction and thus there will be no short term economic impact.

9.5.3.2 Land Application

Construction of the land application alternative may have a minor impact on the local economy. A portion of the effluent forcemain from RBWWTP to the land application facility would follow Route 1, the main thoroughfare into the City. Construction of this portion of the forcemain could potentially restrict the flow of tourists into the area. However, this impact can be minimized by constructing the forcemain during winter months when tourism is lowest.

9.5.3.3 Ocean Outfall

The proposed outfall location and construction is expected to comply with Executive Order 12989-Environmental Justice in Minority Populations and Low-Income Populations, dated February 11, 1994. The selected location is not located in close proximity to a minority or low income community, and no impacts are expected to occur to any minority or low-income communities in the area.

Construction of the ocean outfall alternative is expected to have little to no impact on local business. The majority of the forcemain leading from the RBWWTP to the ocean outfall will be through lightly travelled residential roads, and the proposed outfall staging area is not near any commercial developments. A portion of the forcemain will transverse Rehoboth Avenue / Highway 1, the area’s commercial corridor. The adverse effects of construction on local businesses can be mitigated by constructing appropriate pedestrian and traffic controls and rerouting traffic to minimize temporary reduction in access. The local economy relies heavily on tourism during the summer months, and thus construction should be limited to the winter months to avoid impacts to retail sales.

9.5.4 Long Term / Chronic Impacts

9.5.4.1 No Action

The no action alternative would allow the water quality in Rehoboth Bay to continue to diminish. Poor water quality in the Bay could potentially reduce tourism to the area, which is a major component of the local economy.

9.5.4.2 Land Application

There are many economic benefits of using treated wastewater for irrigation purposes, especially in a situation where water is scarce and the cost of pumping the treated effluent to the fields is reasonable. When treated wastewater is used for agricultural crops, additional benefits have been reported, such as an increase in crop yields, decreased reliance on chemical fertilizer, and increased protection against frost damage (Vigneswaran and Sundaravadivel 2004).

The land application alternative is expected to have only minimal impacts to the local economy. The land set aside for the spray irrigation facility will be prohibited from being used for growing crops and raising livestock for human consumption (DNREC 1999). Since the land requirements for spray irrigation are only a small fraction of the available farm land, the impact to the agricultural industry will be minimal.

9.5.4.3 Ocean Outfall

Negative public perception of the ocean outfall could potentially reduce tourism to the area, and thus have a negative effect on the local economy. However, there was no noticeable difference in tourism to nearby beaches before and after construction of an ocean outfall. The ocean outfall alternative may have a positive effect on local economy by improving the water quality and aesthetics of Rehoboth Bay, and thus increasing tourism to the area.

9.6 Project Financing

9.6.1 Financing Capital Construction

Construction of the ocean outfall will be financed through the WPCRLF. The interest rate on the loan is based on 90% of the national bond yield.

9.6.2 Annual User Charges

9.6.2.1 No Action

Based on the estimated daily water usage and the actual rate structure, the typical current annual user charge was calculated to be $326 for a residential customer within the City of Rehoboth Beach limits (Stearns & Wheler 2009). According to DNREC guidelines, the maximum “reasonable” user charge is 1.5% of the median household income, which equates to $989 for the City of Rehoboth Beach (Stearns & Wheler 2009).

Under the no action alternative, annual user charges are expected to remain at current levels ($326 per resident). However, since treated effluent would continue to be discharged into the Bay, the City of Rehoboth Beach would be in violation of the consent order and be required to pay the associated fines. This could result in increases to the annual user charges to compensate.

9.6.2.2 Land Application

It is estimated that the typical annual user charge for wastewater will increase by a factor of 3.85 (285 %) to approximately $1,255 per year to accommodate the capital and additional O&M cost of a land application (Stearns & Wheler 2009). This user charge is well above the maximum "reasonable" charge according to DNREC guidelines.

9.6.2.3 Ocean Outfall

It is estimated that the typical annual user charge for wastewater will increase by a factor of 1.95 (95 %) to approximately $635 per year to accommodate the capital and additional O&M cost of the ocean outfall alternative (Stearns & Wheler 2009). This user charge is well below the maximum "reasonable" charge according to DNREC guidelines.

9.6.2.4 Comparison of Annual User Charges

The estimated user charges for the different alternatives are compared in Table 9-5. A cost benefit analysis for these three alternatives was also performed and is included in (Appendix B).

Table 9-5 Estimated Annual User Charges (Stearns & Wheler 2009)

Alternative	Annual User Charge
Alternative 1: No Action	$326
Alternative 3: Land Application	
3A: Dedicated spray irrigation facility	Unknown[1]
3B: Raw wastewater to WNRWF with excess flow treated at the IBRWF	$1,160
3C: Raw wastewater to WNRWF with excess flow treated by a PWWP	$1,430
3D: Treated effluent to WNRWF with excess flow sent to the IBRWF	$1,014
3D: Treated effluent to WNRWF with excess flow sent a PWWP	$1,420
Alternative 6: Ocean Outfall	$635

Note:

1. Because of unknowns associated with acquisition of land and construction of a spray irrigation facility, the annual user charges for this option were not calculated.

9.7 Public Health

9.7.1 Short Term / Temporary Impacts

9.7.1.1 No Action

The no action alternative will not involve any construction and thus there will be no short term impact to public health.

9.7.1.2 Land Application

Construction of the land application alternative will have the negligible effects on public health that is inherent to all construction activity.

9.7.1.3 Ocean Outfall

Construction of the ocean outfall alternative will have the negligible effects on public health that is inherent to all construction activity.

9.7.2 Long Term / Chronic Impacts

9.7.2.1 No Action

9.7.2.1.1 Impact of Nutrients

Algae blooms, such as those in Rehoboth Bay, can produce toxins harmful to humans. Because of this and the general poor water quality of the Inland Bays, Rehoboth Bay is currently closed for swimming because of concerns over public health. Nutrients would continue to be discharged into the Bay by RBWWTP under the no action alternative, which would slow the recovery of the Bay.

9.7.2.1.2 Impact of Bacteria and Viruses

Under normal operation at RBWWTP, the concentration of enterococcus at the point of discharge are already below the state water quality criteria, so the poor dilution of the Bay is not relevant.

9.7.2.1.3 Impact of Metals, Volatiles, and Semi-Volatiles

The State of Delaware Surface Water Quality Standards established water quality criteria that are protective of human health for systemic toxicants and human carcinogens, which include metals, as well as volatile and semi-volatile organic compounds. The RBWWTP effluent was analyzed for 13 metals, 85 volatile and semi-volatile organics, and phenolic compounds (see Section 5.4 and (Appendix F)). Only copper and the semi-volatile compound BEHP were detected at concentrations higher than that allowed by the Surface Water Quality Standards.

Copper and BEHP must undergo dilution of 1:3 and 1:4 respectively to achieve compliance with the most stringent limit imposed by DNREC Surface Water Quality Criteria. Even in the poorly mixed Bay, it is expected that this small amount of dilution occurs rapidly, so the impact to human health is minimal.

9.7.2.1.4 Impact of Pharmaceuticals

Filtration and disinfection processes at RBWWTP produces a tertiary effluent, so the residual concentrations of PPCPs with the treated effluent is expected to be minimal (Snyder, et al. 2007). Additional dilution within Rehoboth Bay may be limited due to the low movement of water within the Bay. Although less than 1% of the pharmaceuticals detected in the Bay are from human sources (Wise, O'Brien and Woodruff 2011), discharging effluent into the Bay will continue to contribute to the high levels of pharmaceuticals, such as estrogen, observed in the Bay.

9.7.2.2 Land Application

9.7.2.2.1 Impact of Nutrients

Under the land application alternative, additional nutrient removal will occur for most forms of nitrogen and phosphorus as the treated effluent percolates through the soil and into the shallow aquifer. The nutrient of primary concern is nitrate, a soluble form of nitrogen, which will not be retained by soil particles and tends to move with the groundwater. The nitrate concentration in the percolate must not exceed the state drinking water standard of 10 mg/L (State of Delaware Department of Health & Social Services 2003) (DNREC 1999). Of the 6 mg/L of total nitrogen within the treated effluent, only 4 to 5 mg/L is nitrate, so the drinking water standard is met even before crop uptake and soil percolation provide additional treatment.

9.7.2.2.2 Impact of Pathogenic Organisms in Aerosols

One of the concerns of wastewater effluent discharge using land application is the potential human inhalation from aerosol formation. Among various techniques of land application, spray or sprinkler irrigation is believed to generate the maximum amount of aerosols (Raynor and Hayes 1976). Even though aerosols generated from spray irrigation represents only one percent of the total discharged water, the size of the aerosols is small enough both to remain suspended in the atmosphere for considerable time and to penetrate and be deposited in the lower respiratory tract (Sorber 1974).

Bacterial aerosols remain viable and travel further with increased wind velocity, increased relative humidity, and lower temperatures and darkness because sunlight promotes decay of airborne microorganism. A study showed that under night-time conditions, which are characterized by lower wind speed and increased atmospheric stability (the resistance of the atmosphere to vertical motion), microorganism levels in aerosols were slightly greater than daytime conditions (Sorber 1974) (Johnson, et al. 1980) (Bausum, et al. 1982). Extensive monitoring of the aerosols generated at a spray irrigation facility in Pleasanton, California showed that the concentration of bacteria in aerosols is also reduced by distance. The microorganism level in aerosols at 100-200 yards downwind is lower than at the downwind edge of the spray irrigation site. Based on the reported enterovirus density, a worker on duty eight hours per day at 50 yards would inhale only one enterovirus each nine days (Johnson, et al. 1980).

The concentration of bacteria in aerosol produced by spray irrigation using treated wastewater depends on the quality of wastewater effluent. Additional disinfection treatment of wastewater is very effective in reducing the levels of microorganisms in wastewater by 2-3 orders of magnitude (Majeti and Clark 1980). When chlorinated effluent was examined, at least 95.4% reductions in bacteria count could be expected (Bausum, et al. 1982).

Growing vegetable or grazing animals on an actively irrigated land treatment site is prohibited. Since public access to land application site is also restricted (DNREC 1999), any possible human exposure to aerosols (direct or indirect) could be reduced to a very minimal level.

9.7.2.2.3 Impact of Pathogenic Organisms in Groundwater

The fact that pathogenic microorganism can survive on soil, vegetation, surface water, and even ground water, poses a potential threat to public health. Human contact with pathogenic organisms is possible through the soil surface or inhalation of contaminated aerosols. In addition, runoff from land application site may broaden the contamination of pathogens to surface water. Bacteria and parasites generally are removed to a greater extent than enteric viruses during infiltration through soils, thus viruses are of greater concern when exposure is to the effected ground water. Estimates of infection risks from the accidental ingestion of 100 ml of final effluent from advanced municipal wastewater treatment effluent ranged from approximately 1 in 10,000 for *Cryptosporidium* to 2 in 100 million for viruses. Similarly, estimates of annual risks to those exposed to a specific use of ground water recharged with a chlorinated secondary sewage effluent ranged from 8 in 100 million to 1.5 in billion. Currently, the control of such risks below 1 in 10,000 is considered acceptable (NRC 1994).

The RBWWTP provides an advanced level of treatment that includes filtration. Filtration will remove *Cryptosporidium* and Giardia. The disinfection process using chlorine kills essentially all of the bacteria, but some viruses will remain in the effluent. Public health is further protected by proper design of land application site and by creating limited access to general public. For example, spray irrigation using treated wastewater for open public spaces, e.g. park, shall be limited to specific periods of time when the public is effectively excluded from accessing the site. For this particular use, wastewater must be treated to a high level (i.e. 5-day biochemical oxygen demand ≤ 30 mg/L, total suspended solids ≤ 30 mg/L, fecal coliform ≤ 200 colonies/100 mL) to avoid risk of spreading disease (DNREC 1999). The RBWWTP produces an effluent of even higher quality than these minimum requirements.

9.7.2.2.4 Impact of Metals, Volatiles, and Semi-Volatiles

Soils have a finite capacity to retain trace metals; however, for typical municipal effluent including the RBWWTP effluent, soils can typically retain trace metals for hundreds of years (DNREC 1999). In general, concentrations for trace metals should be below the concentrations presented in Table 9-6. Concentrations within the RBWWTP treated effluent is typically on the order of one thousandth that of the required limit.

Table 9-6 Assessment criteria for inorganic constituents in treated effluent applied to land (DNREC 1999)

Trace Metals	Concentration
Aluinum	<10 mg/L
Arsenic	<0.2 mg/L
Beryllium	<0.2 mg/L
Boron	<0.5 mg/L
Cadmium	<0.02 mg/L
Chromium	<0.2 mg/L
Cobalt	<0.1 mg/L
Copper	<0.4 mg/L
Iron	<10 mg/L
Lead	<10 mg/L
Lithium	<2.5 mg/L
Manganese	<0.4 mg/L
Molybdenum	<0.02 mg/L
Nickel	<0.4 mg/L
Selenium	<0.04 mg/L
Zinc	<4.0 mg/L

Organics, such as volatiles and semi-volatiles, are not absorbed from the soil by plants, but can be stored in the soil or stabilized by soil bacteria (DNREC 1999). Organic chemicals are removed to varying degrees by volatilization or chemical or biological degradation during passage through the vadose zone.

Delaware regulations require regular testing of soils and groundwater for priority pollutants (DNREC 1999).

9.7.2.2.5 Impact of Pharmaceuticals

Traces of pharmaceuticals and personal care products (PPCPs) are commonly found in effluent treated soils, ranging from low parts-per-billion to parts-per-million levels (Walters, McClellan and Halden 2010). The concentration of some PPCPs such as azithromycin (antibiotics), carbamazepine (epilepsy drug), and miconazole (fungicide), will naturally degrade over time. Some other such as diphenhydramine (antihistamine), fluoxetine (antidepressant), and thiabendazole (fungicide), show no discernable loss over three years of monitoring (Walters, McClellan and Halden 2010). Different soil types have different capability to remove pharmaceuticals contents. A study by Gielen, et al (2009) found that carbamazepine was very efficiently removed (>99%) when irrigated onto a volcanic sandy loam soil. This was in contrast to irrigation onto a sandy soil where no carbamazepine removal occurred after irrigation.

The fact that PPCPs can be found on soil, vegetation, surface water, and even ground water, poses a potential threat to public health. Reported impacts of PPCPs include the occurrence of antibiotic resistant bacteria (Kim and Aga 2007) and endocrine disruption such as reduce fertility in animals (Benoff, et al. 2003). However, due to their low concentrations, no direct human impact due to PPCPs has ever been reported.

The RBWWTP provides an advanced level of treatment so the treated effluent is expected to have a very low level of pharmaceutical contents. Public health is further protected by proper design of land application site and limitations on general public access. For example, spray irrigation using treated wastewater for open public spaces, e.g. parks, shall be limited to specific periods of time when the public is effectively excluded from accessing the site.

9.7.2.3 Ocean Outfall

9.7.2.3.1 Impact of Nutrients

As discussed in Section 2.4.2, the RBWWTP effluent has average concentrations of 6.2 mg/L TN and 0.35 mg/L TP. Sampling of the ambient water quality, in the vicinity of the proposed outfall, was completed in November 2010 and June 2011. The results with respect to nutrients are presented in Table 9-7 (see (Appendix K)).

Table 9-7 Ambient nitrogen and phosphorus concentrations in the vicinity of the proposed outfall

Nutrient	RBWWTP Effluent Concentration	November 2010 Recorded Levels	June 2011 Recorded Levels	Dilution Required
Nitrogen	6.2 mg/L	0.44 mg/L	0.37 mg/L	1:17
Phosphorus	0.35 mg/L	0.066 mg/L	0.059 mg/L	1:6

The dilution factors required to dilute the effluent TN and TP to less than background levels are 1:17 for TN and 1:6 for TP. This will occur in the initial zone of dilution in the immediate vicinity of the diffuser.

9.7.2.3.2 Impact of Pathogenic Organisms

The criteria established for water quality to be protective of human health is the enterococcus standard established by DNREC for primary contact in marine waters. The ability of the ocean outfall to meet water quality criteria for primary contact marine waters is based on the expected concentration of the indicator organisms in the effluent under various operating conditions. As discussed in Section 2.4, the RBWWTP provides a tertiary level of treatment with chlorine disinfection which reduces the number of pathogenic organisms to very low levels. Dilution provided by the initial and far field mixing of the discharge plume with the ocean water provides further reductions in the concentration of organisms surviving the treatment process. The amount of dilution achieved is based on the plume dispersion model developed for the proposed Rehoboth Beach outfall. The model provides the dilution contours achieved during steady state conditions (one-year continuous operation) at a confidence level of 95% given the physical and hydrodynamic conditions specific to the proposed outfall location.

A further clarification regarding the study approach with respect to the concentration of pathogenic organisms is relevant at this point. In reality, the various types of organisms potentially present in a treated effluent are inactivated by natural processes in the marine environment. These natural processes include the effects of sunlight and UV radiation, salinity, predation by other organisms and other effects related to temperature, dissolved oxygen and nutrient availability.

The survival rates of bacteria and viruses will be discussed in this section, but for the purpose of assessing the risk of exposure to the effluent discharged through the outfall it will be assumed that there is no die-off. Thus, the risk assessment and analysis of compliance with the DNREC water quality criteria for primary contact recreation will be based on the conservative assumption that the only reduction in pathogen concentrations will be through dilution due to the initial and far-field dilution of the effluent in the ocean water.

There has been considerable research into the ability of pathogenic organisms to survive in the natural environment. Survival rates are highly variable and dependent on a number of factors including the specific species of organism but some general guidelines, in terms of days of survival in fresh water, are shown in Table 9-8 for bacteria and virus. It should be noted that survival rates in salt water is considerably less than in fresh water.

Table 9-8 Survival rates for bacteria and viruses in fresh water (Metcalf & Eddy 2004)

Pathogen	**Survival Time (days)**	
	Less than	Usually less than
Bacteria		
Fecal Coliform	60	30
Salmonella spp	60	30
Shigella	30	10
Vibro cholerae	30	10
Viruses		
Enteroviruses	120	50

A study of the survival of the human enteroviruses conducted in Hawaiian coastal waters indicated that enteric viruses were rapidly inactivated in the ocean (Fujioka, Philip and Lau 1980). The time required to reduce the number of poliovirus particles by 90% was two days. More than 99% inactivation was achieved in two days for the coxsackievirus and the echovirus. It was noted that the inactivation rate was much less in clean water leading to the hypothesis that bacterial predation was the primary cause of the inactivation.

Again, for the purposes of this study, it is assumed that no die-off occurs. It is assumed that the only reduction in the concentration of pathogens is through dilution. This approach is therefore conservative.

Compliance with water quality criteria under various operating conditions; both normal and non-standard operating conditions are considered in the following sections. The different modes of operation, based on potential modes of failure at the wastewater treatment plant, are discussed. As stated previously, compliance with water quality criteria is based on the concentration of the indicator organism enterococcus. However, the potential level of virus contamination is also discussed. Section 5.3 discusses the concentration of pathogenic organisms typical of municipal wastewater after various levels of treatment and specifically as expected in the RBWWTP effluent.

In addition to normal operations of the RBWWTP, the non-standard or failure modes of operation that are evaluated include:

- Failure of disinfection process
- Failure of tertiary process

Failure of the biological process is not a realistic scenario. This would imply that the primary and backup blowers for aeration (total four), the draft tube aerators in the oxidation ditches (two ditches / two draft tubes each) and the return activated sludge pumps (total four) have all failed. This has never occurred and as stated previously, the proactive preventive maintenance program at the RBWWTP ensures that both the primary and backup mechanical systems are available for operation. If there was a complete power failure, then the RBWWTP would essentially become a very large primary settling process. However, there would be no discharge from the RBWWTP since all effluent must be pumped to the ocean outfall. There have been power outages in the past, but they are typically quickly resolved while RBWWTP continues to operate on the second, backup source of normal power.

In addition to all of the backup mechanical and electrical systems, the RBWWTP has two large circular flow holding tanks that can be used to temporarily hold wastewater while repairs are made to a piece of equipment under emergency conditions. The tanks have a total capacity of 1.8 million gallons.

9.7.2.3.2.1 Normal Operation

Normal day-to-day operation is characterized by all unit process at RBWWTP in operation and the effluent being disinfected by chlorination. Historically, this has been the only condition under which the RBWWTP has operated. The RBWWTP has been in continuous operation since 1987 and has never been out of compliance with its discharge permit. Continuous reliable operation is assured through the design of the facility and through the operation and maintenance procedures implemented at RBWWTP. RBWWTP has two parallel trains of operation, each with redundant mechanical units. This allows for continued reliable service even with the potential for mechanical problems. Only half of the RBWWTP is required to provide treatment in the winter due to the greatly reduced flows. Thus, maintenance requiring tanks or mechanical systems to be taken out of service can be scheduled for the off season. There are two independent sources of normal power at RBWWTP. If one source were to fail then the other source automatically comes on line.

The assumed level of pathogenic organisms in the effluent during normal operation is presented in Table 9-9. The level of enterococcus is based on actual plant performance as described in Section 2.4.

Table 9-9 Assumed level of pathogenic organisms in effluent during normal operations

Parameter	Assumed level
Enterococcus	2 CFU / 100 mL
Virus	10 PFU/100 mL

9.7.2.3.2.2 Failure of Disinfection Process

Should the chlorine metering process fail or the plant run out of hypochlorite, the effluent would be typical of a tertiary non disinfected effluent. This is extremely unlikely to occur because there are backup chemical metering pumps and the plant continuously monitors the inventory of chemicals to anticipate delivery requirements. Also, should this extremely unlikely event occur, the RBWWTP operating personnel could quickly set up a temporary manual hypochlorite feed system to continue the disinfection process. The assumed level of pathogenic organisms in the effluent when there is a failure in the disinfection process is presented in Table 9-10. The concentration of organisms in the effluent is based on data from other treatment facilities as presented in Section 5.3.

Table 9-10 Assumed level of pathogenic organisms in effluent during a failure of disinfection process (Rose, et al. 2001)

Parameter	Assumed level
Enterococcus	2.2×10^3 CFU / 100 mL
Virus	1.8×10^3 PFU / 100 mL

9.7.2.3.2.3 Failure of Tertiary Process

In this scenario, the filtration system located just upstream of the chlorine contact tanks fails in addition to a failure of the chlorine disinfection process as discussed in Section 9.7.2.3.2.2. The existing filtration system utilizes microscreens (two parallel units) to further remove particulate matter. Typically the RBWWTP does not need to operate these units because the secondary effluent from the final clarifiers upstream of the microscreens are very efficient and able to reduce the effluent solids to below permit requirements (15 mg/L TSS).

Currently the City of Rehoboth Beach is planning on replacing the existing microscreens with a newer, more effective technology. It is proposed that the microscreens be replaced with rotating disc cloth filters. Two units operating in parallel would be provided for redundancy. Disc filters are a proven technology for wastewater filtration. This type of filter has been used previously in California to produce Title 22 reuse water.

The filtration system would be operated continuously, but if for any reason they are bypassed while at the same time there was a failure of the chlorine disinfection system, the assumed level of pathogenic organism removal is as presented in Table 9-11. The level of pathogens is assumed to be the same as the previous failure mode where disinfection is lost with the addition of Oocysts (Giardia and Cryptosporidium) which could potentially be present due to loss of filtration.

Table 9-11 Assumed level of pathogenic organisms in effluent during a failure of tertiary process and disinfection

Parameter	Assumed level
Enterococcus	2.2×10^3 CFU / 100 mL
Virus	1.8×10^3 PFU / 100 mL
Oocysts	1.5×10^3 Cysts/ 100 mL

Table 9-12 summarizes the anticipated level of enterococcus in the effluent during normal operation and under the other non-standard modes of operation. Also provided is the percent dilution of the effluent required in the receiving waters in order to achieve compliance with state water quality criteria for enterococcus for primary contact marine waters.

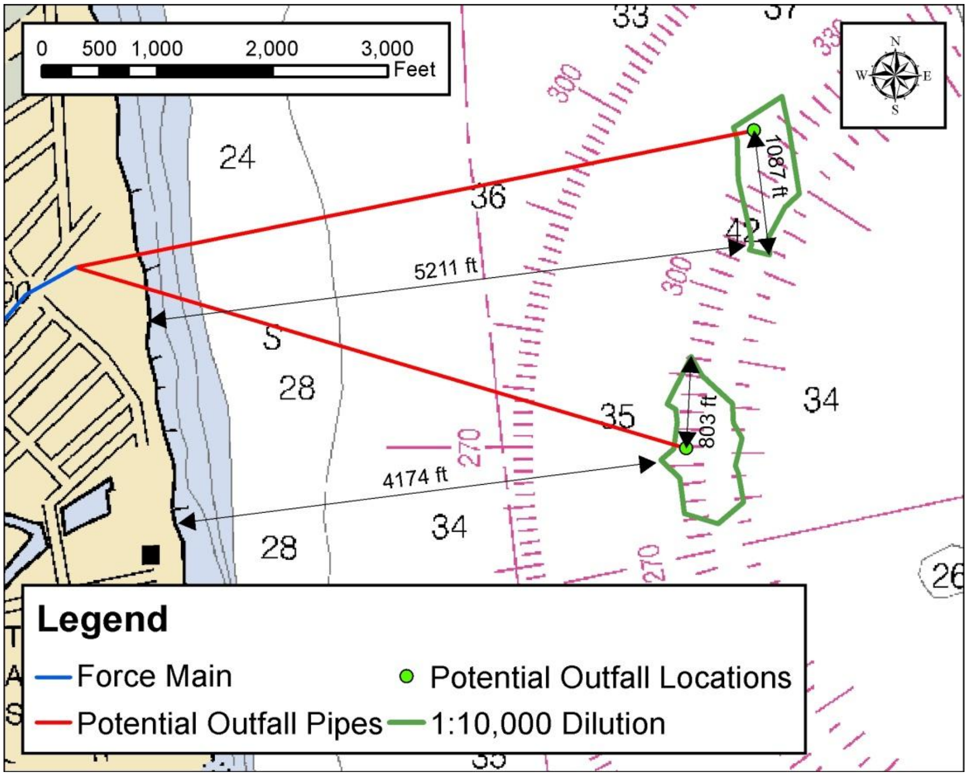
Table 9-12 Pathogen levels and dilution required under various operating scenarios

	Number per 100 mL			Dilution Required
Operating Condition	Enterococcus (CFU/100 mL)	Virus (PFU/100 mL)	Oocysts (Cysts/100 mL)	
Normal	2	10	0	None
Failure of the Disinfection Process	2.2×10^3	1.8×10^3	0	1:100 (2 log)
Failure of the Disinfection and Filtration Processes	2.2×10^3	1.8×10^3	1.5×10^3	1:100 (2 log)

Modeling of the plume dispersion from the outfall provides contour plots of the dilution achieved in the near field and far field. The contours were based on continuous steady state operation over a one-year period with a confidence level of 95% reflecting all of the different hydrodynamic conditions that could exist in the vicinity of the outfall during that time period. As can be seen in Figure 9-9 a Log 4 (10,000x) dilution is achieved within close proximity to the outfall diffuser. The area required for a Log 2 dilution, which is the minimum required under the failure modes described previously, is even smaller and more confined to the immediate vicinity of the diffuser.

If a mechanical failure were to occur, the length of time the RBWWTP would operate at reduced efficiency is limited to the time required to repair the equipment. A full year steady state representation of the dilution contour is excessively conservative. In reality, the operating condition would only last a short while, and the dilution would not have time to reach steady state.

Figure 9-9 Enterococcus Dilution



Note: Preliminary contour. Actual contour to appear in final report

9.7.2.3.3 Impact of Metals, Volatiles, and Semi-Volatiles

The State of Delaware Surface Water Quality Standards established water quality criteria that are protective of human health for systemic toxicants and human carcinogens, which include metals, as well as volatile and semi-volatile organic compounds. The RBWWTP effluent was analyzed for 13 metals, 85 volatile and semi-volatile organics, and phenolic compounds (see Section 5.4 and (Appendix F)). Only copper and the semi-volatile compound BEHP were detected at concentrations higher than that allowed by the Surface Water Quality Standards.

Copper and BEHP must undergo dilution of 1:3 and 1:4 respectively to achieve compliance with the most stringent limit imposed by DNREC Surface Water Quality Criteria. The near field model developed as part of this report (see model results in Chapter 6 and (Appendix J)) indicates that a 1:4 dilution occurs almost instantaneously. Even the run scenario representing the poorest conditions for mixing and dilution predicts a 1:82 dilution to be achieved within the near field region. Therefore even though the concentrations of some pollutants do not meet water quality standards within the effluent, dilution with the ocean water will rapidly lower the concentrations to levels far below the DNREC Surface Water Quality Criteria.

9.7.2.3.4 Impact of Pharmaceuticals

After the wastewater effluent has been discharged to the surface water, the residual PPCPs concentration will be further reduced by dilution. A study by Glassmeyer, et al. (2005) examined the concentrations of 110 chemicals within the treated effluent of ten WWTP locations across the country. Concentrations where also measured within the receiving stream at a site near the WWTP discharge (site D1) and at a site further downstream (D2). Table 9-13 presents the percentage change in the number of detected compounds and total PPCP concentration between the three sites. The trends in both the number of compounds and the total concentration suggest that, with additional distance from WWTP processes (e.g., dilution, degradation, sorption, etc.), the chemical concentrations decrease with transport downstream.

Table 9-13 Percent change between sample sites for the number of detected chemicals and total PCCP concentration (Glassmeyer, et al. 2005)

Sample site comparisons	Median Percent Change	
	Number of PPCP compounds	Total PPCPs concentration
WWTP effluent – Downstream 1	-3.1%	-47.8%
WWTP effluent– Downstream 2	-23.0%	-70.9%
Downstream 1– Downstream 2	-14.4%	-52.2%

Considering the used of advanced treatments at the RBWWTP, the residual concentration of PPCPs expected to remain in final effluent would be very minimal. Once the effluent discharged through the ocean outfall, dilution in the ocean will further greatly reduce the residual concentration. For example,if the concentration of a PPCP at the diffuser or the outfall discharge was 1 ppb; then, the concentration would be reduced to 0.0001 ppb within 1,600 ft (490 m) of the outfall (see Figure 9-9). At distances further from the outfall, the residual PPCP concentration would be further diluted to concentration levels too low to affect the environment or human health.

9.8 Noise

9.8.1 Short Term / Temporary Impacts

9.8.1.1 No action

The no action alternative will not involve any construction and thus there will be no increase in noise levels.

9.8.1.2 Land Application

Minor short term impacts to noise would result from the construction phase of the forcemain and land application facility. As with any construction project, heavy equipment utilized for the pipeline construction would result in intermittent noise levels within the 80 to 100 dBA range (Center to Protect Workers' Rights 2001). This is roughly equivalent to the noise produced by a truck (90 dBA) or a motorcycle, (95 – 110 dBA) (Center for Hearing and Communication 2011).

9.8.1.3 Ocean outfall

Minor short term impacts to noise would result from the construction phase of the forcemain and ocean outfall. As with any construction project, heavy equipment utilized for the pipeline construction would result in intermittent noise levels within the 80 to 100 dBA range (Center to Protect Workers' Rights 2001). This is roughly equivalent to the noise produced by a truck (90 dBA) or a motorcycle, (95 – 110 dBA) (Center for Hearing and Communication 2011). Since construction of the forcemain is only along existing roads, the construction noise will not be significantly greater then ambient traffic. In addition, the noise impacts of construction activity will be minimized by constructing during the winter months.

Dredging activities at the proposed location would produce noise levels in the 70 to 90 dBA range but would be restrictive to area offshore. This noise would be masked by the surf background noise and by the distance to populated areas.

9.8.2 Long Term / Chronic Impacts

9.8.2.1 No action

The no action alternative will not result in any changes to noise levels.

9.8.2.2 Land Application

The forcemain leading from the RBWWTP to the land application site will be underground and thus will generate no detectable noise after construction is complete. The spray irrigation facility will generate some noise, but this is expected to be minimal.

Growth and development in the service area of the RBWWTP could increase ambient noise levels. However, the treatment capacity of the RBWWTP will not be impacted by the land application alternative, and thus, this alternative will not encourage any growth or development.

9.8.2.3 Ocean outfall

The entire forcemain and ocean outfall will be underground or underwater and thus generate no detectable noise after construction is complete.

Growth and development in the service area of the RBWWTP could increase ambient noise levels. However, the treatment capacity of the RBWWTP will not be impacted by the ocean outfall alternative, and thus, this alternative will not encourage any growth or development.

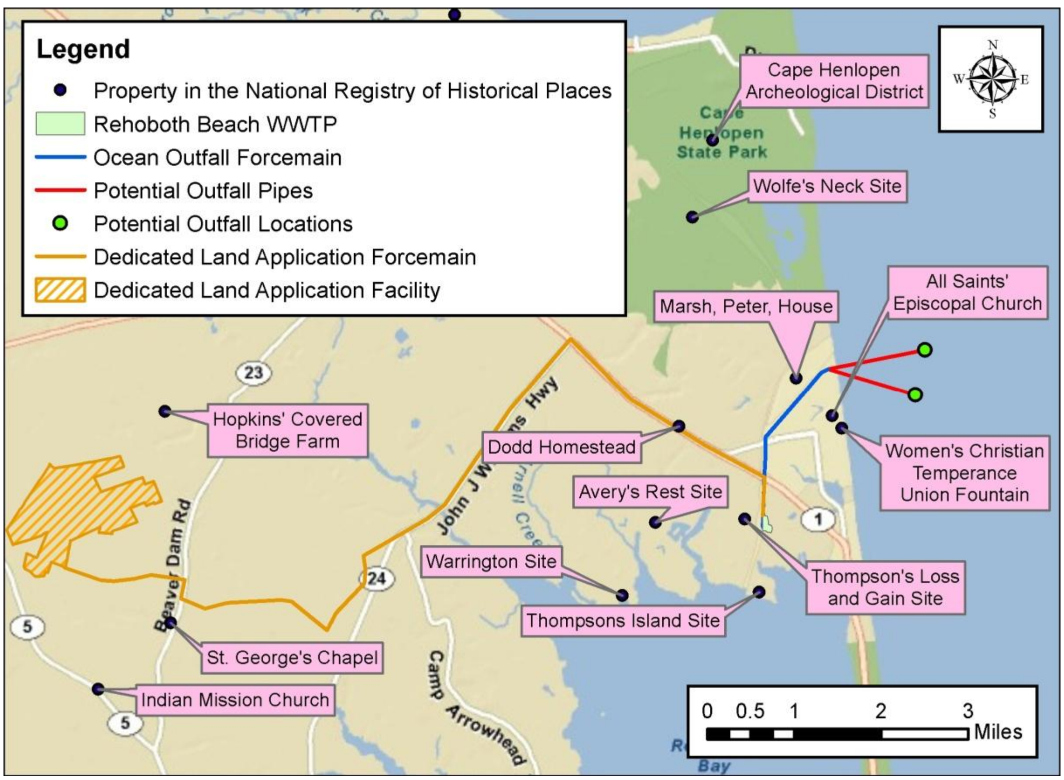
9.9 Historic/Archeologic

9.9.1 National Historical Preservation Act

The selected effluent disposal alterative must meet the requirements of Section 106 of the National Historical Preservation Act of 1966. This act "requires Federal agencies to take into account the effects of their undertakings on historic properties and afford the [Advisory Council of Historical Preservation] a reasonable opportunity to comment on such undertaking" (Advisory Council on Historic Preservation (ACHP) 2004).

The National Register of Historic Places lists properties recognized for their significance in American history, architecture, archeology, engineering, and culture (Advisory Council on Historic Preservation (ACHP) 2011). Historic sites listed in the register are shown in Figure 9-10.

Figure 9-10 Properties listed in the National Register of Historic Places (Advisory Council on Historic Preservation (ACHP) 2004).



As mentioned in Chapter 4, a review by the DNREC, Delaware Division of Parks and Recreation (Clark 2011) was performed during the November 2011 under the provisions of Section 106 of the National Historic Preservation Act (amended 1966) and in coordination with the Delaware State Historic Preservation Office. It was concluded that the ocean outfall project is an undertaking for Section 106 review that has the potential to affect historic properties in limited areas of force main construction on land and offshore. Offshore discussion review can be found in Section 9.9.2.3.

According to the DNREC review (Clark, 2011), The City of Rehoboth Beach developed from a farm to a resort community in the late 19th century in a setting that has been occupied over time by Native American, Afro-American and European settlers. Though historic buildings will not be affected by the project, Columbia Avenue is an historic concrete road, which may be a contributing element to the 1937 modern subdivision of Henlopen Acres. Therefore, additional evaluation and measures to avoid open cut construction in Columbia Avenue are recommended for the force main option (Clark 2011).

In addition, the Lewes and Rehoboth Canal is an historic structure, which was completed through Rehoboth by the mid-1920's. Thus, there is a potential that spoil from construction may overlie the banks of the canal and protect a buried historic landscape in this vicinity. Potential archaeological sites may include both historic and Native American sites. It is expected that limited archaeological survey will be necessary in areas of open cut force main construction, including the area oat Deauville Beach, that are outside of the street layout. For open cut construction within the street layout on Henlopen Avenue, no archaeological survey is recommended because buried utilities from stormwater, sewer and lateral connections have widely disturbed the underlying soil stratigraphy. Thus, Alternative A in the Rehoboth Beach Wastewater Treatment Plant Effluent Force Main Alignment Study attached in (Appendix G), the force main route along the Lewes Rehoboth Canal and within Henlopen Avenue, is the preferred alternative (Clark 2011).

9.9.2 Short Term / Temporary Impacts

9.9.2.1 No action

The no action alternative would not result in any impact to historical or archeological sites as no new construction will occur.

9.9.2.2 Land Application

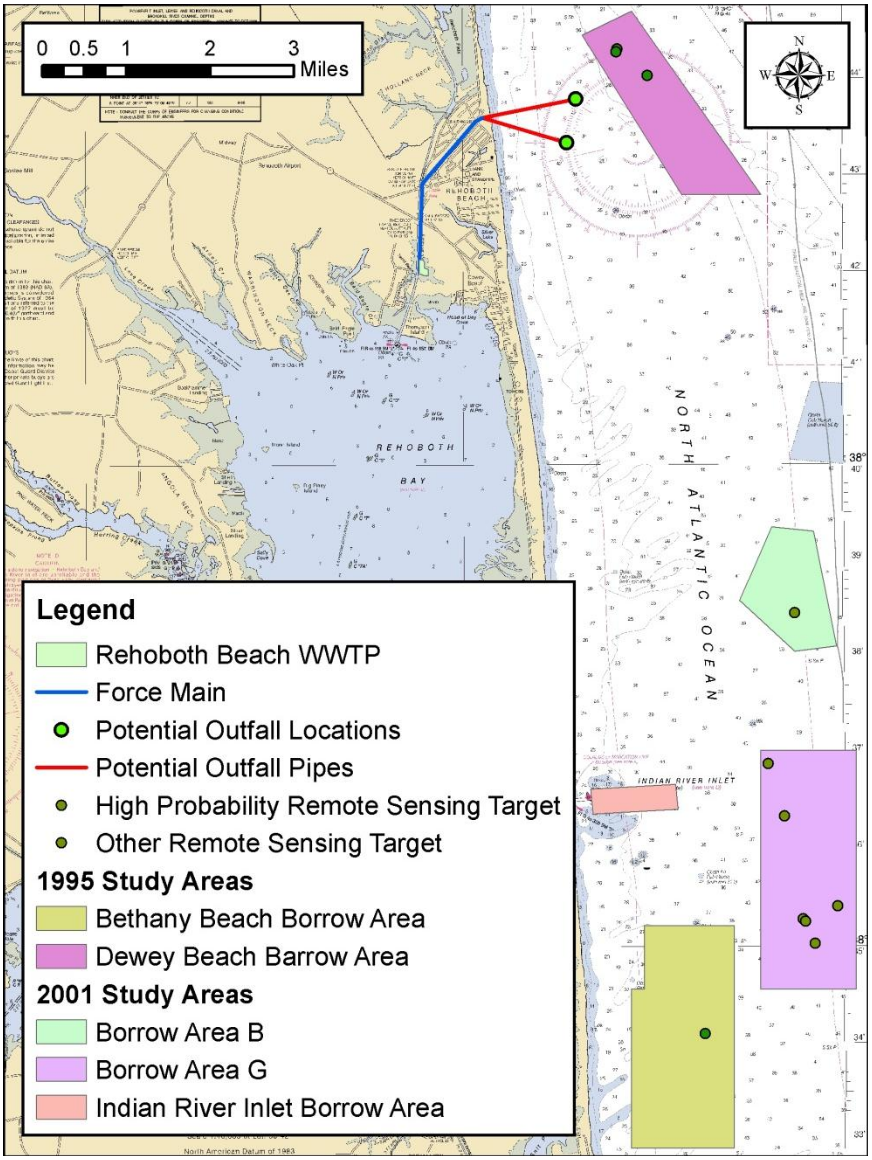
The proposed alignment for the land application effluent forcemain, as shown in Figure 9-10, would be in close proximity to the "Dodd Homestead", a property listed in the National Register of Historic Places. Construction of the forcemain in the vicinity of this site will require mitigation techniques, including, but not necessarily limited to, utilizing directional drilling methods.

9.9.2.3 Ocean outfall

The ocean outfall alterative could potentially impact nearby archeological/historical sites, which may be located on land or submerged off the coast of Delaware.

Submerged cultural resources in the area of the ocean outfall must be detected by ship based archeological surveying. In 1995 and 2001, detailed surveys of nearby areas were completed, but the area in the vicinity of the outfall was not surveyed. The areas surveyed in 1995 and 2001 and the locations of any found targets are shown in Figure 9-11.

Figure 9-11 Extents and Found Targets of Previous Submerged Cultural Resource Surveys

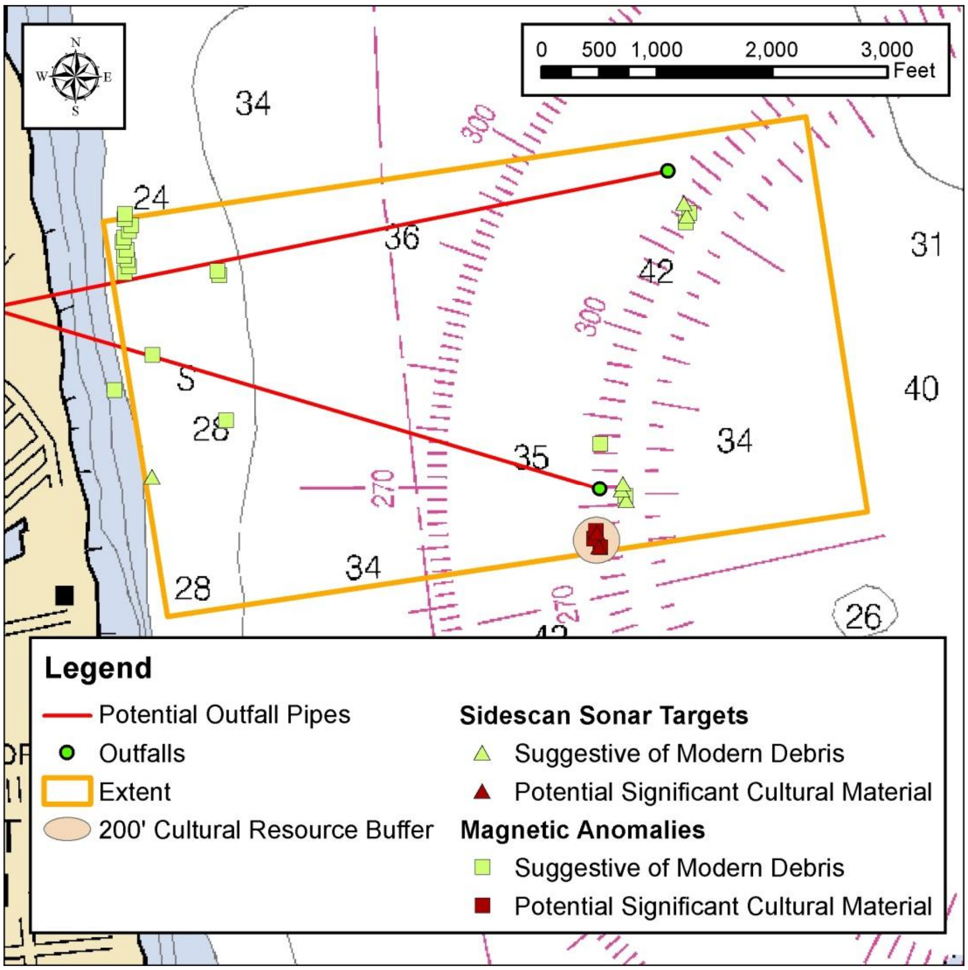


A magnetometer and side-scan sonar survey was performed by Tidewater Atlantic in the vicinity of the potential ocean outfall from July 11 to July 15, 2011. This report is included in (Appendix O) of this report. The area surveyed and the location of any found targets are shown in Figure 9-12.

Within the surveyed area, 22 magnetic anomalies and eight sonar targets were identified. An additional magnetic anomaly was detected near the survey area but not investigated further. Sixteen magnetic anomalies and one sonar target are suggestive of isolated modern debris, such as fish and crab traps, pipes, rods, cable, wire rope, chain, or small boat anchors. Three magnetic anomalies and five sonar targets were associated with the ADCP buoys deployed at the proposed outfall locations.

Three magnetic anomalies and two sonar targets, located towards the southern end of the surveyed area, displayed characteristics that are indicative of potential cultural resources. It is recommended that the objects producing these signatures be protected by a 200 ft (70 m) buffer. The southern outfall is approximately 350 ft from the nearest potential cultural resource target. .

Figure 9-12 Extents and Found Targets of 2011 Submerged Cultural Resource Survey



As mentioned in this section, a review by the DNREC, Delaware Division of Parks and Recreation (Clark 2011) was performed during November 2011 under the provisions of Section 106 of the National Historic Preservation Act (amended 1966) and in coordination with the Delaware State Historic Preservation Office. It was concluded that the ocean outfall project is an undertaking for Section 106 review that has the potential to affect historic properties in limited areas of force main construction on land and offshore.

According to the DNREC review of the Tidewater Atlantic, Inc. report included in (Appendix O) of this report, one target area with potentially significant cultural resources was identified near the end of the alignment trending SSE (southern outfall location). This anomaly would require additional underwater survey to conclude that it is historic. No significant anomalies were associated with the alignment trending due east (northern outfall alignment) from Rehoboth Beach. It was concluded that the east trending route (northern outfall alignment and outfall) would have the least impact on cultural resources (Clark 2011).

9.9.3 Long Term / Chronic Impacts

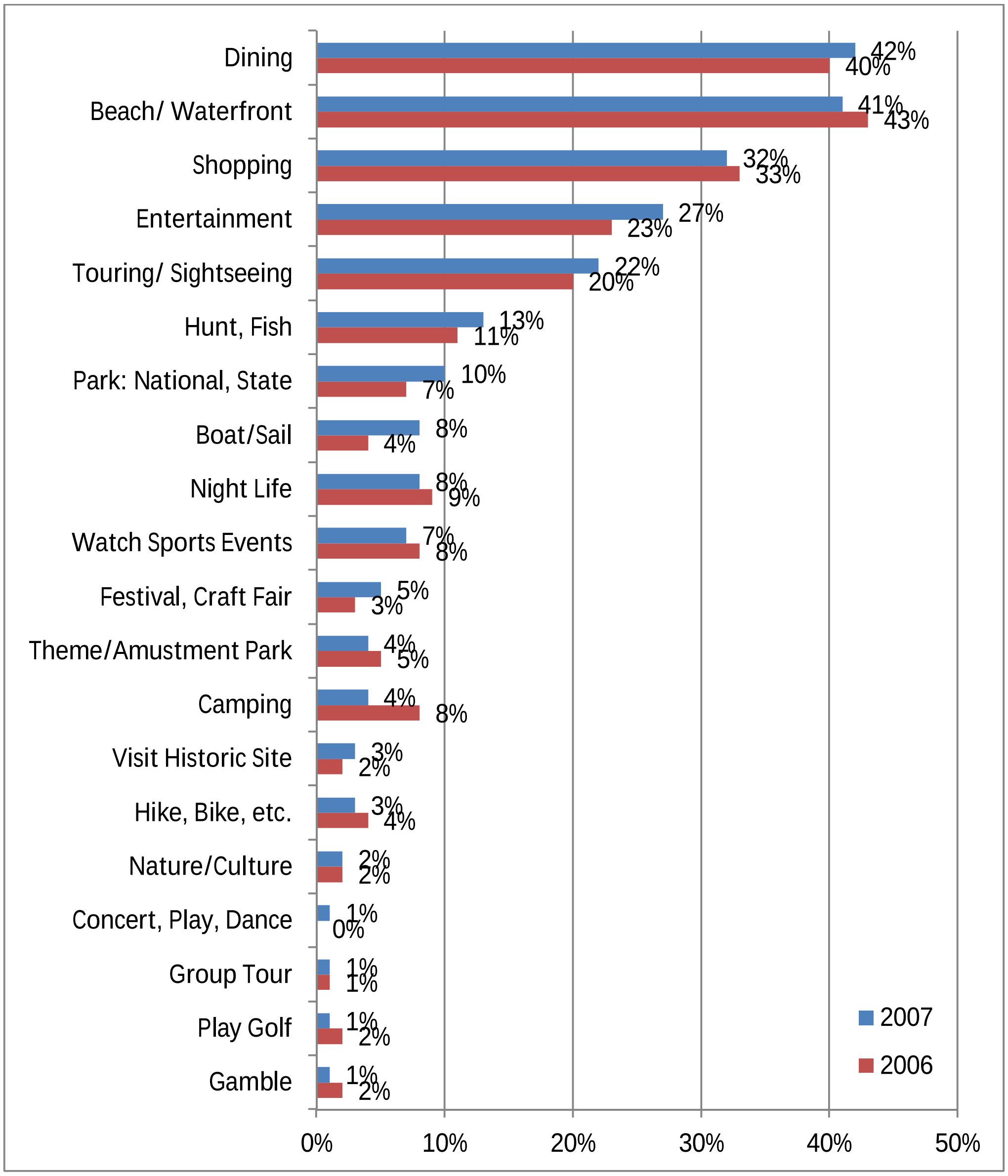
After land application or discharge in a body of water, the treated effluent is not expected to have any direct, long term impact on historical or archeological sites. Any impact to historical or archeological sites will occur during construction and are detailed in Section 9.9.2.

9.10 Aesthetics/Recreation

9.10.1 Trip Activities in Sussex County

Of the person-trips (trips per person) into Sussex County in 2007, 42% of person-trips involved beach/waterfront activities, making this the second most popular activity after dining. Many other activities are dependent on the coastal and inland waters, including touring and sightseeing (22%), hunting and fishing (13%), and boating and sailing (8%) (Delaware Economic Development Office (DEDO) 2007). Other trip actives in Sussex County are listed in Figure 9-13.

Figure 9-13 Trip Activities in Sussex County (Delaware Economic Development Office (DEDO) 2007)



9.10.2 Short Term / Temporary Impacts

9.10.2.1 No action

The no action alternative will involve no construction, so there will be no short term impacts to aesthetics or recreation.

9.10.2.2 Land Application

Construction for the land application alternative would cause disruption along the forcemain alignment, which could potentially impact the public's recreational usage of nearby beaches for the duration of construction. The land application facility is located more than five miles away from the beach, so its construction is unlikely to affect beach usage.

9.10.2.3 Ocean outfall

Construction for the ocean outfall alternative would impact the public's recreational usage of the nearby beach for the duration of construction. The staging area of the directional drilled portion of the pipeline is located in a parking lot used by beach goers and would have to be closed during construction. The trenching ships and directional drilling barge would be far enough off shore to not have a direct impact on visits to the beach but would definitely decrease the aesthetic appeal. Beach tourism varies by season and is minimal during the winter months. If construction of the outfall is performed during this time of the year, there would be very little impact to users of the beach.

9.10.3 Long Term / Chronic Impacts

9.10.3.1 No action

Continuing to discharge effluent into Rehoboth Bay under the no action alternative will not allow the poor water quality of the Bay to improve. As such, the Bay will continue to be unsuitable for recreational activity, such as fishing. Algae blooms and other effects of overenrichment would continue as well, diminishing the aesthetic appeal of the Bay.

9.10.3.2 Land Application

The land application facility is located more than five miles inland from the ocean and will thus have minimal to no impact on users Rehoboth Beach. The facility would be highly visible to nearby members of the public, but it is not expected to detract from the current aesthetics of the area. The land will be restricted for use as a land application facility, which will prevent any further development that could potentially diminish the aesthetic appeal of the area.

9.10.3.3 Ocean outfall

The forcemain and outfall piping will be buried below grade and have no long term impact on the recreational use or aesthetics of the area. The distance of the outfall from the shore would ensure no impact on the recreational use or aesthetics of the beach. As discussed in Chapter 5 of this report, the RBWWTP treated effluent meets criteria for primary contact in marine waters, even without dilution. However, to account for possible failure of the disinfection process, the state may delineate a "no-swim" area in the vicinity of the outfall. Since this area would be located more than a mile off-shore, it is unlikely that swimmers would be in the area, so impacts to recreation will be minimal. Similarly, fishing close to the outfall may be prohibited as a precaution.

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